AT the meeting of the International Meteorological Committee at Paris in 1885, Dr. H. Wild, of St. Petersburg, and Prof. E. Mascart, of Paris, were requested to take the initiative in the publication of a series of international meteorological tables, to allow of a uniform method of reduction of the observations being everywhere carried out, and a specimen has now been printed and issued for criticisms. The work contains (1) a description of the tables and of their use, in English, French, and German; (2) equivalents of various units, and general tables used by different countries for meteorology, magnetism and electricity. The volume will occupy nearly 440 pages quarto, and will cost about 30*s*. The Committee request each country to contribute to the expense of publication by subscribing for a certain number of copies.

WE have received the results of meteorological observations made in New South Wales during 1885, under the direction of H. C. Russell, B.A., F.R.S., the Government Astronomer, forming a compact octavo volume of 360 pages, with plates of meteorological curves for each month. The great increase in the number of rainfall and river stations has made it necessary to publish these observations in a separate volume. Some important additions have been made to the information given in past years, and the barometric curves have been so arranged as to show the various changes through all the stations at one view. The tables show (1) the most important data for the whole colony; (2) the data for each station separately; (3) the barometric curves; and (4) the monthly abstracts published during the year. Considerable attention has been paid to the amount of evaporation in various parts of the colony, and the quantities for some districts are found to be much below what has often been stated, depending very much upon the state of the soil. The year 1885 was one of serious drought, although the total rainfall for the year was only 10 per cent. below the average, owing to heavy rainstorms at the end of January. The total rainfall at Sydney was 39·78 inches measured on 145 days. The greatest fall was in June, and the least in August. The mean temperature for the year was 63° 9. The maximum in the shade was 97°·6 on November 5, and the minimum 40°·6 on June 30. The mean temperature of the whole colony for 1885 was 63°·0, or 1°·7 in excess of the mean for 15 years. The absence of cloud, and the drought, have had a decided effect upon the temperature of the whole colony, showing apparently a direct relation between rainfall and temperature.

THE PROBLEM OF THE HOP PLANT LOUSE (PHORODON HUMULI, SCHRANK) *IN EUROPE AND AMERICA.*[1]

THE author has been for several years carrying on investigations with a view of ascertaining the full annual life-history of *Phorodon humuli*, and especially with a view of settling the hitherto moot question as to its winter life. The importance of the inquiry, both from the economic and the scientific sides, is self-evident. The hop crop, in all parts of Europe where it is grown, and especially in England, annually suffers more or less from the ravages of this its worst insect enemy, and in some years is a total failure. The same is true in North America, at least east of the Rocky Mountains, and last year the injuries of this Phorodon in the hop-growing regions of the State of New York were so great that many hop yards were abandoned and have since been ploughed up; while but 10 per cent. of an average crop was harvested. From the purely scientific side, entomologists, notwithstanding the great interest attaching to the subject, have been divided in opinion as to the identity, or specific relationship, of the hop Phorodon and one that occurs on Prunus, while the complete annual cycle of the insect's life has remained a mystery. After full and satisfactory investigations I have satisfied myself that, contrary to the prevailing impression among hop growers and previous investigators, the hop plant louse does not hibernate underground on the roots of the hop, nor in, on, or about anything in the hop yard; but that, upon the advent of the first severe frosts, the hop plant and the hop yards are entirely cleared of the species in any form. I find that all statements to the contrary in America are based on misapprehension, or mistaken identity of species, and I believe (though admitting the possibility of variation in this respect in milder climates) that the same will be found to hold true in England, where hibernation on the hop root has been accepted by high authority. The positive statements made about eggs being laid in autumn, whether on roots or upon the vines left in cutting, or which are carted away, are based on conjecture, and have been blindly copied without credit by one writer from another, a practice too common among second-hand writers on economic entomology.

The conjectures of some of the best students of aphidology that *Phorodon humuli* had a form (*malaheb*, Fonsc.) living on Prunus, and that there was a consequent migration from one plant to the other, I have positively proved to be correct, by direct colonizing from Prunus to Humulus, and by continuous rearing from the original stem-mother hatched from the winter egg.

The observations have been made on growing plants and in vivaria at Washington, and checked by others made simultaneously in hop yards at Richfield Springs, N.Y. An incident may here be recorded as illustrating the effect of meteorological extremes upon Aphides. The extreme heat (over 100° F.) and dryness of July 17 and 18 killed every one of the insects under observation at Washington, entirely clearing the plants. The economic bearing of such exceptional phenomena, as also of the biological observations made, is readily understood.

The more important conclusions from the studies so far made are thus summed up in a paper which I had the honour to read before the American Association at its recent meeting in New York:—

(1) *Phorodon humuli* hibernates in the winter egg state, this egg being fastened to the twigs (generally the previous year's growth) of different varieties and species of Prunus, both wild and cultivated. The egg is difficult to detect, because it is covered with particles which resemble the bark in colour and appearance. It is usually laid singly, and when freed of disguising particles is seen to be ovoid and 0·04 mm. long.

(2) The annual life-cycle is begun upon Prunus by the stem-mother, which hatches from this winter egg. The stem-mother is stouter than the individuals of any of the other generations, with the legs, antennæ, and honey-tubes relatively shorter, while the cornicles between the antennæ are sub-obsolete. The colour is uniform pale green, with bright red eyes and faintly dusky tarsi.

(3) Three parthenogenetic generations are produced upon Prunus, the second at once distinguished by its more elongate form, much longer members, distinct cornicles and markings of darker green; while the third (or typical *malaheb* form) becomes winged, and instinctively abandons the plum and migrates to Humulus. The habit of moving from plant to plant after giving birth to an individual, and thus scattering the germs of infection on Humulus, is well marked in this winged generation.

(4) During the development of the three plum-feeding generations, the hop is always free, and subsequently, until the return migration, the plum becomes more or less fully free from infection by this species.

(5) A number of parthenogenetic wingless generations are produced on the hop (seven, or the tenth from the stem-mother on plum, having been traced up to August 5, and advices of the eleventh, up to August 19, have been received since my arrival in England); and, finally, there is a return migration of winged females to the plum in autumn. The wingless hop generations are not only incapable of migrating to the plum, but do not thrive upon it when artificially transferred thereto.

(6) Exact observations are not yet complete as to the full number of generations produced upon the hop before the winged return migrant appears, and another month's careful watching and experiment is needed to fill this hiatus in the annual cycle, as also to ascertain the exact number of generations produced in autumn on the plum. From knowledge extant and previous general observation, the facts will probably prove to be as follows:—

(7) The eleventh or twelfth generation will produce winged females (from the middle to the end of August), which will deposit their young upon the plum, and these will become the only sexed individuals of the year, the male winged and the female wingless, the latter after coition consigning a few impregnated or winter eggs to the twigs.

(8) Up to August 5 the first females on hop were still alive and breeding, having existed two months. There is, consequently, an increasing admixture of generations from the first

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[1] Abstract of a Paper read before Section D of the British Association for the Advancement of Science, at Manchester, by Prof. C. V. Riley, on September 3.

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on hop until frost overtakes the species in all conditions and sweeps from the hop yards all individuals alike, perpetuating in the egg state those only which reached the sexual condition on the plum.

(9) Each parthenogenetic female is capable of producing on an average 100 young (the stem-mother probably being more prolific) at the rate of one to six, or an average of three per day, under favourable conditions. Each generation begins to breed about the eighth day after birth, so that the issue from a single individual easily runs up, in the course of the summer, to trillions. The number of leaves (700 hills, each with two poles and two vines) to an acre of hops, as grown in the United States, will not, on the average, exceed a million before the period of blooming or burring; so that the issue from a single stem-mother may under favouring circumstances blight hundreds of acres in the course of two or three months.

(10) While meteorological conditions may materially affect the increase and power for injury of the species, these are far more truly predetermined and influenced by its natural enemies, many of which have been studied and will be described.

(11) The slight colorational differences, as also the structural differences, including the variation in the cornicles on head and basal joints of antennæ, whether upon plum or hop, are peculiarities of brood, and have no specific importance whatever.

(12) The exact knowledge thus gained simplifies the protection of the hop plant from Phorodon attack. Preventive measures should consist in destroying the insect on plum in early spring where the cultivation of this fruit is desired, and the extermination of the wild trees in the woods wherever the hop interest is paramount; also in avoiding the introduction of the pest into new hop countries in the egg state upon plum cuttings or scions. Direct treatment is simplified by the fact that the careful grower is independent of slovenly neighbours, infection from one hop yard to another not taking place.

Experiments still under way have shown that there are many effective remedies, and that the ordinary kerosene emulsion diluted with twenty-five parts of water and sprayed with the cyclone nozzle, or a soap made by boiling one pound of pure potash in three pints of fish oil and three gallons of water, and this dissolved in eight gallons of water, and sprayed in the same way, are thoroughly effectual remedies, and leave the plant uninjured. The former costs 75 cents, the latter 30 cents, per acre, plus the time of two men for three hours, plus appliances. The object of further experimentation now being carried on is to simplify and reduce the cost of these last to a minimum. As they consist, however, essentially of a portable tank and a force-pump with hose and spraying attachment, which, together, need not involve a greater first outlay than 5 dollars to 10 dollars, and as every American hop grower can afford to expend the larger sum for the protection of a single acre, there is no longer any excuse for allowing this pest to get the better of us.

It is not my purpose, however, to enter into aphidicide details in this communication, which I will conclude by brief reference to the bearings of these discoveries in America on the problem in Great Britain. The most comprehensive and satisfactory review of the knowledge possessed on the subject in England that has come to my notice, is that by my esteemed friend and correspondent, Miss Eleanor A. Ormerod, Consulting Entomologist of your Royal Agricultural Society, in her "Report of Observations of Injurious Insects," &c., made in 1885. So far as her own careful observations are concerned, they fully accord with the facts here set forth; but on the authority of others, and especially on the evidence of Mr. C. Whitehead, who reported finding young lice and large viviparous females on hop shoots as early as March 29, and that of Mr. A. Ward, who experimented with surface dressings near Hereford, Miss Ormerod concludes that attack on the hop begins in spring from wingless females which come up from the hop hills, and, as a corollary, that dressings to prevent such ascent are strongly to be recommended. It is quite within the range of possibility, and what is known of aphid life, that where the winters are mild, with scarcely any frost, this Phorodon may continue on the hop from one year to another in the parthenogenetic condition. If such is ever the case in England, you have a somewhat different set of facts to deal with here from what we have in America. But for the reasons already stated in abstract, from many other detailed observations which it would be tedious to record here, as well as from the ease with which erroneous conclusions are arrived at in entomological matters of this kind, where not checked and proved by the most competent and careful study, I shall be inclined to believe that the facts in England are essentially the same as I have found them in America, until convincing and trustworthy evidence to the contrary be forthcoming. Mr. Whitehead may have had another species under observation, and Mr. Ward's surface dressings may have acted by repelling the winged female migrating from Prunus, in the same way that buckwheat sown among the hops is believed to do with us.

EDUCATION IN GERMANY.

THE following letter appeared in the *Times* on the 10th inst.:—

SIR,—I should be glad if you could find space in your columns for some remarks on the state of education in Germany. I have just completed a short tour in this country, mainly to inquire into its educational system, especially with reference to primary and technical schools. England has at last roused herself to the necessity for technical education.

The Bill, which was unhappily crowded out last session, will be reproduced next year, and, I trust, expanded to larger dimensions. It will contain, I hope, a clause for the establishment of evening continuation schools, for which object I gave notice of an amendment last session. My trip to Germany has been chiefly taken to learn what is doing here in this direction, and what is the drift of educated German opinion. With your permission I will briefly summarize my impressions. I premise by observing that each State of the German Empire manages its own education, and that the laws and regulations differ somewhat, so that general statements referring to all Germany cannot be made without qualifications. I will not weary your readers, however, by going into details respecting each State, but place broadly before them the general features of German education.

The salient fact which strikes all observers is the universality of good education in this country. There is no such thing as an uneducated class; there are no such things, speaking broadly, as neglected and uncared-for children. All classes of the community are better educated than the corresponding ones in our country; and this applies quite as much to primary as to secondary education. Nothing struck me more than the general intelligence of the humbler working classes. Waiters, porters, guides, &c., have a knowledge of history, geography, and other subjects far beyond that possessed by corresponding classes in England, and the reason is not far to seek. The whole population has long been passed through a thorough and comprehensive system of instruction obligatory by law and far more extended than is given in our elementary schools. I went through several of these schools and observed the method of teaching, which was simply admirable. The children are not crammed, but are taught to reason from the earliest stages. The first object of the teacher is to make his pupils comprehend the meaning of everything they learn, and to carry them from stage to stage so as to keep up an eager interest.

I saw no signs of weariness or apathy among either teachers or scholars. The teaching was all *vivâ voce*, the teacher always standing beside the blackboard and illustrating his subject by object-lessons. The instruction was through the eye and hand as well as the ear, and question and answer succeeded so sharply as to keep the whole class on the *qui vive*. The teachers are, as a body, much better trained than in England, and seem to be enthusiasts in their calling, and the school holds a far higher position in the social economy of the country than it does with us. What I am saying here applies equally to Switzerland as to Germany, and for educational purposes Zurich will compare with any part of this empire. The main advantage, however, that primary education has in Germany over England lies in the regularity of attendance and the longer period of school life. There is none of the difficulty of getting children to school that exists in England; the laws are very rigid and permit no frivolous excuses, and, what is even more important, the people entirely acquiesce in the laws, and are inclined rather to increase than relax their rigour. It is well known that in London and all our great cities a large part of the population seek to avoid school attendance by every means in their power, and consequently the attendance is most irregular. There is very little of this in Germany; at least I have not found it so. Then in our country a great portion of our children are withdrawn altogether from school, after passing the fourth or fifth standard, at the age of eleven or twelve, whereas in Germany almost

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